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Aging and the Fitness of Fire Fighters: The Complex Issues Involved in Abolishing Mandatory Retirement Ages

Kurt Saupe, MS, Mark Sothmann, PhD, and Deborah Jasenof, MS

ABSTRACT

This study presents an assessment of the cardiorespiratory health and physical fitness of fire fighters of different ages with the aim of addressing several questions currently being debated on a national level. These include how fire fighters differ across age groups in their health and physical fitness, and what would be the impact on the existing work force of implementing minimum fitness standards as an alternative to mandatory retirement ages.

Fire fighters aged 20–65 years were found to be similar in their cardiorespiratory health and physical fitness to the sedentary segment of the general population of the same age. Particularly worrisome, however, is the low maximal aerobic capacity (31, 28, 26 ml/kg/min), high percent body fat (26, 29, 30), and high resting blood pressure (136/86, 140/90, 143/93 mm Hg) observed in the 40–45-, 50–55-, and 60–65-year-old fire fighters, respectively. In fact, 66%, 83%, and 93% of the fire fighters in these three age groups, respectively, fall below the lowest published recommendations for maximal aerobic capacity in this profession.

These data underscore the need to establish minimum health and physical performance standards for fire fighters and demonstrate the profound impact such minimum standards will have on the existing work force. (*Am J Public Health*. 1991;81:1192–1194)

Introduction

The feasibility of abolishing mandatory retirement ages in public safety occupations is being studied under US congressional mandate. One suggestion has been to replace mandatory retirement ages with minimum standards for health and physical fitness.[1] Before serious discussion regarding developing and implementing standards can begin, the impact of those standards on the current work force must be known. Therefore, we conducted a descriptive case study of a large municipal fire department (approximately 5000 uniformed personnel) in order to (1) describe differences across age groups in selected measures of physical fitness and health using a cross-sectional design and (2) develop hypotheses on the impact of implementing physical performance standards on the existing work force

Methods

Subjects were recruited from a randomized listing of all uniformed full-time fire fighters from a large municipal fire department. The 150 subjects were divided by age into five groups of 30 each: aged 20 to 25, 30 to 35, 40 to 45, 50 to 55, and 60 to 65 years. No more than 40 individuals in each age group had to be contacted in order to obtain the 150 volunteers.

Cardiovascular status was determined from a graded exercise test employing a modified Balke treadmill protocol. ECG, blood pressure, and heart rate were taken at rest; at the end of each stage of exercise; and at 1, 3, and 5 minutes during recovery. Expired gases were collected during the last 1 to 4 minutes prior to volitional fatigue or symptom-limited test termination. Maximal oxygen uptake (VO2max) was measured using an open circuit system as described elsewhere.[2]

Pulmonary function testing was performed using a Collins Survey Spirometer. From a forced vital capacity (FVC) maneuver, forced expiratory volume at 1 second (FEV1) and forced expiratory flow rate between 25% and 75% of FVC (FEF25–75) were calculated using standard procedures.

Percentage of body fat was estimated based upon skinfold thickness of the abdomen, chest, and thigh as measured with a Lange skinfold caliper. The average of three measurements at each site was used in a regression equation to predict percentage of body fat.[3]

Measurements of grip strength, standing long-jump, and situps were made for inclusion with selected cardiovascular and anthropometric variables in the composite fitness evaluation system developed by Davis et al.[4]

Analysis of variance using a post hoc Scheffe test was employed to determine any statistically significant ($P < .05$) differences between the age groups.

Results

Aerobic capacity significantly decreased from the 20- to 25-year-old group (47.7 ml/kg/min) to the 30- to 35-year-old group (37.9 ml/kg/min) and from the 30- to

At the time of this study, all three authors were with the Department of Human Kinetics, University of Wisconsin, Milwaukee. Kurt Saupe is now with the Physiology Department of the University of Wisconsin, Madison.

Requests for reprints should be sent to Kurt Saupe, 504 N Walnut Street, University of Wisconsin, Madison, WI 53705.

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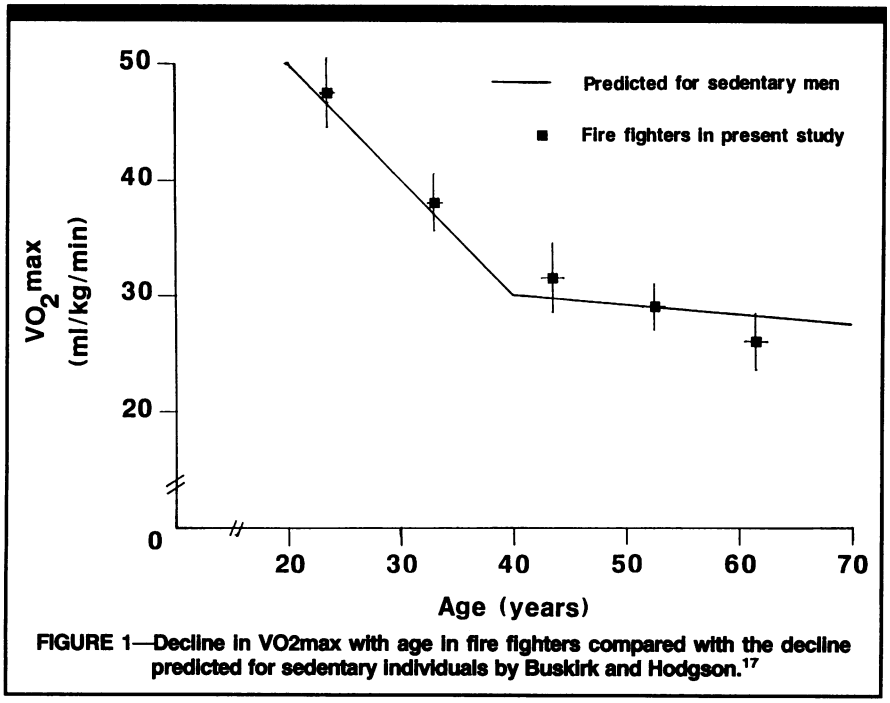

FIGURE 1—Decline in VO2max with age in fire fighters compared with the decline predicted for sedentary individuals by Buskirk and Hodgson.[17]

TABLE 1—Percentage of Fire Fighters above Proposed Minimum Values for VO2max

Proposed Values	Age Groups[a] 20–25	30–35	40–45	50–55	60–65	Reference
3.0 l/min	83	73	27	33	3	13,14
42 ml/kg/min	87	20	3	0	0	15
39 ml/kg/min	93	40	13	3	3	16
33.5 ml/kg/min	100	83	33	17	7	5

[a]n = 30 for each group.

TABLE 2—Characteristics of Fire Fighters across Age Groups[a]

Characteristics	Age Groups[a] 20–25	30–35	40–45	50–55	60–65
Resting systolic blood pressure (mm Hg)[b]	128 ± 10	133 ± 7	137 ± 14	141 ± 15	142 ± 15
Resting diastolic blood pressure (mm Hg)[b]	72 ± 12	82 ± 9	86 ± 9	88 ± 11	88 ± 7
Forced vital capacity (l BTPS)[b]	4.99 ± 0.5	5.30 ± 0.6	4.76 ± 0.7	4.53 ± 0.6	3.80 ± 0.6
FEVl (l BTPS)[b]	4.19 ± 0.4	4.26 ± 0.5	3.70 ± 0.7	3.62 ± 0.5	2.82 ± 0.7
FEF25–75 (l/s)[b]	4.69 ± 0.8	4.43 ± 1.0	3.47 ± 1.1	3.80 ± 1.1	2.32 ± 1.1
% Smokers	10	33	33	27	10
% Previous smokers	10	27	43	50	80
% Never smoked	80	40	23	23	10
% Who exercise more than twice per week	60	40	17	10	33

Note: BTPS = body temperature and pressure, saturated; FEV1 = forced expiratory volume at 1 second; FEF25–75 (l/s) = forced expiratory flow rate between 25% and 75% of forced vital capacity.
[a]n = 30 for each group.
[b]Data are expressed as mean ± standard deviation.

35-year-old group to the 40- to 45-year-old group (31.5 ml/kg/min) (Figure 1). Given these values for VO2max, Table 1 indicates the percentage of fire fighters in each of the five age groups who would pass various published recommendations for VO2max in fire fighters.

Resting data on blood pressure and pulmonary function are presented for each of the age groups in Table 2. Both systolic and diastolic pressures are significantly higher in the 50- to 55-year-olds and 60- to 65-year-olds than in the 20- to 25-year-olds. FVC was significantly less in the 60- to 65-year-olds than in the 20- to 25-year-old group. Also presented in Table 2 are self-reported data on smoking history and physical activity.

Figure 2 presents lean body weight and fat weight across age groups. Percentage of fat increased significantly from ages 20 to 25 years (8.3%) to 30 to 35 years (19.4%) and again from 30 to 35 years to 40 to 45 years (27.2%).

Table 3 indicates the percentage of fire fighters in each age group exceeding certain clinical criteria. Fire fighters with over 25% body fat are considered to be moderately obese.[5] Individuals with a resting diastolic pressure (DBP) between 90 and 114 mm Hg or a systolic pressure (SBP) greater than 140 mm Hg are considered to the borderline to moderately hypertensive[6] and are categorized as such in Table 3. The percentage of fire fighters in each age group manifesting positive stress tests according to criteria established by the American College of Sports Medicine[7] are listed in Table 3. Exercise hypertension (SBP > 250 or DBP > 120) was the most frequently observed problem in fire fighters aged 40 to 55. In con-

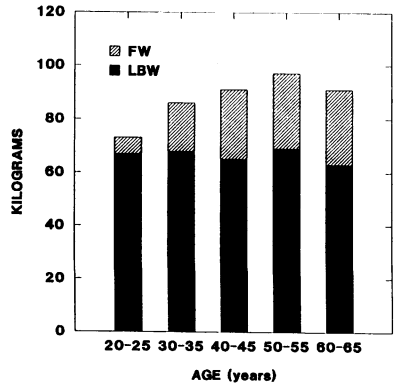

FIGURE 2—Lean body weight (LBW) and fat weight (FW) as a portion of total body weight in fire fighters across age groups.

TABLE 3—Percentage of Fire Fighters in Each Age Group Exceeding Selected Clinical Criteria

Criteria	Age Groups[a] 20–25	30–35	40–45	50–55	60–65
> 25% Body Fat	0	27	60	83	77
Borderline to moderate hypertension	20	33	53	70	73
Positive exercise stress test	0	0	7	10	40
Mild to moderate pulmonary impairment	10	13	30	23	53

[a]n = 30 for each group

trast, 10 of the 12 positive stress test results in the 60- to 65-year-old age group were due to ECG abnormalities. The average VO2max of the fire fighters with positive stress tests was 24.5 ml/kg/min. Individuals with either an FEV1/FVC of less than .74 or an FVC less than 79% of predicted[8] are considered to have mild to moderate pulmonary impairment[9] and are also presented in Table 3.

A test battery for assessing the overall physical fitness of fire fighters, which includes measures of strength, cardiovascular status, and pulmonary function and has been shown to be predictive of performance time on a standardized fire suppression test,[4] was also used. According to this rating system, 38% of fire fighters aged 40 to 45, 60% aged 50 to 55, and 96% aged 60 to 65 would be considered poor in their overall fitness for fire fighting.

When fire fighters in each age group were divided into those who reported exercising more than twice a week and those exercising less than twice a week, no significant differences in VO2max, percentage of body fat, or FVC were observed.

Discussion

This case study of a large metropolitan fire department illustrates the complexity of the mandatory retirement age issue faced by municipalities. These data suggest that substantial age-associated declines do occur in the health and physical fitness of fire fighters, although these declines are not necessarily age-dependent. Although fitness standards have been advocated as an alternative to mandatory retirement ages, the data presented here demonstrate that using published recommendations as standards[2,10,13] for the aerobic fitness of fire fighters would have an "adverse impact"[14] on a large segment of the existing work force. Given the existing legal controversies pertaining to adverse impact, a municipality would have to present considerable justification for any proposed standard, which would involve costly research and litigation.[15,16] Lowering standards to avoid adverse impact is legitimate only if public safety is not compromised. Our data suggest that any consideration of a shift in national policy away from mandatory retirement ages should be accompanied by an in-depth examination of the feasibility of developing and implementing medical and fitness standards at the municipal level, and clarification of the controversial issue of whether fitness standards that have adverse impact on certain protected groups are necessary to maintain public safety. □

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